Enhanced low temperature reaction for the CO_2 methanation over Ru promoted Cu/Mn on alumina support catalyst using double reactor system

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ABSTRACT

The bimetallic copper with manganese (Cu/Mn) on alumina (Al_2O_3) support have been considered as potential catalyst for the carbon dioxide methanation due to the low cost and its unique ability to facilitate the conversion of carbon dioxide (CO_2) to methane gas (CH_4). However, high operating reaction temperature limits their large scale industrial application. In order to address this challenge, a series of low ruthenium (Ru) content promoted on Cu/Mn supported onto Al_2O_3 have been design by wet impregnation method. The potential catalyst was tested catalytic acitivity by using single and double reactors. The influences of Cu/Mn ratios and Ru contents on the catalytic activities and physicochemical properties of prepared catalysts were investigated. The addition of Ru can improve the catalytic activity and the basicity of the catalysts surface. As a result, their low-temperature reaction had been enhanced over these doped Ru promoted catalysts. The optimal catalyst was 3Ru60Cu/Mn-Al_2O_3 where the CO_2 conversion reached 98.2% with the methane selectivity of 100% at 220°C by using single reactor. Interestingly, the reaction temperature was reduced at 170°C when using double reactor which the CO_2conversion reached 95.6% with the methane selectivity of 100%. The stability test showed that the Ru promoted on Cu/Mn-Al_2O_3 catalyst maintained its high reactivity after 7 h.

KEYWORDS:

CO_2 methanation; Low temperature reaction; Ruthenium catalyst; Copper catalyst; Double reactor